UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/806,459	03/23/2004	Sergey Zhidkov	2557-000175/US	1227

30593 7590 04/04/2008

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

EXAMINER	
KING, SONIA J	

ART UNIT	PAPER NUMBER
2611	

MAIL DATE	DELIVERY MODE
04/04/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/806,459	ZHIDKOV, SERGEY	
	Examiner	**Art Unit**	
	Sonia J. King	2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-48* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-35 and 37-49* is/are rejected.

7)☒ Claim(s) *36, 40* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 34 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claim preamble states " *wherein **one** of the following applies:"* and it is not clear from the claim language where the word ***"and"*** appears between claim limitations if these claim elements are meant to be considered together as 1 limitation or if this conjunction is simply meant to link the last limitation to the rest of the claim. Note, if the applicant intends simply link the last limitation to the rest of the claim it would be best to use the word ***"or"*** so that the meaning of the claim as a whole is consistent with the claim preamble. For purposes of claim interpretation and analysis, the claim is understood to be linking the last limitation to the rest of the claim as explained above.

Response to Arguments

1. Applicant's arguments filed 12/12/2007 have been fully considered but they are not persuasive. The arguments presented by the applicant have been discussed below and the previous rejection maintained since the applicant has only made editorial amendments to the claims.

Independent claim 1

Applicant argues: Arambepola does not disclose an "equalized signal", contrary to the Examiner's statement on p. 3 ¶4.

Examiner's Response: Regarding claim 1, the examiner agrees that the previous Office Action states that Arambepola does not disclose an "equalized signal". However, the supplemental reference, Nielsen US Patent 5692010, does teach an equalized signal (Abstract, Figure 1) and as such, the combined teaching of Arambepola/Nielsen teaches an equalized signal; therefore the examiner will maintain the rejection in view of the combined teaching taken as a whole, and make the correction to the rejection in this Office Action.

Applicant argues: Arambepola does not disclose "estimating impulse noise" in a received signal. Instead, it discloses detecting impulse noise and comparing the detected impulse noise to a pair of thresholds (related to amplitude and duration). Thus, Arambepola can be more properly characterized as determining whether or not impulse noise is present, rather than estimating the impulse is present, rather than estimating the impulse noise itself.

Examiner's Response: In this instance, detecting is not different from estimating since according to Arambepola (paragraph 0011 step c), samples indicating the start and end of the impulse noise and subsequent action (step d) taken on those particular sets shows that estimation has taken place.

Applicant argues: Arambepola does not disclose removing a portion of noise from a received signal. Instead, it discloses zeroing out the received signal if the detected impulse noise exceeds the pair of thresholds discussed above. Thus, it removes the received signal itself, not a portion of noise from the signal.

Examiner's response: Arambepola teaches, *"Impulsive noise comprises one or more discrete relatively high amplitude pulses or relatively short duration and can disrupt reception to an unacceptable extent" (paragraph 0002).* In view of this, Arambepola also teaches (step d *comprises*) replacing the or each sample of each set for which the step (c) indicates the presence of a noise impulse (paragraph 0012). Therefore, the entire signal is not zeroed out, and if it were, that would still include "a portion of noise from the received signal". Moreover, a sample is not the entire signal but a portion of it.

Applicant argues: Because of the previous arguments, Arambepola does not disclose "estimating impulse noise in the equalized signal".

Examiner's response: The examiner asserts that the response to each of the arguments presented above have been discussed in a manner that dispels the previously presented arguments and based on the combined teaching of Arambepola and Nielsen taken as a whole, "estimating impulse noise in the equalized signal" is taught.

Applicant argues: Arambepola does not disclose “removing a portion of the noise from the equalized signal as a function of the estimated impulse noise”.

Examiner’s response: A function by definition is: *a variable so related to another that for each value assumed by one there is a value determined for the other*. Therefore, since the estimated impulse noise is being removed from the received signal, and in the instance of Arambepola samples are taken which as previously discussed are removed, then in effect those samples can be likened to a function of the signal.

Applicant argues: Nielsen does not disclose “estimating impulse noise” in a received signal. Instead, it discloses detecting impulse noise and comparing the detected impulse noise to a threshold (related to amplitude). Thus, Nielsen can be more properly characterized as determining whether or not impulse noise is present, rather than estimating the impulse noise itself.

Examiner’s response: Again, detecting and determining are not different from estimating in this instance, since Nielsen provides a way to gauge or assess the impulse noise and then to take action on it, as taught by the Abstract.

Applicant argues: Nielsen does not disclose removing a portion of noise from a received signal. Instead, it discloses zeroing out a feedback signal if the detected impulse noise exceeds the threshold related to amplitude discussed above. Thus, it zeroes out a feedback signal, but it does not remove a portion of noise from the received signal.

Examiner's response: The whole purpose of the threshold circuit is to reject impulse noise in the error signal or feedback signal (Abstract). Therefore, the feedback signal can be considered the portion of the received signal since it has the impulse noise that will be removed.

Applicant argues: Because of the above, Nielsen does not disclose "estimating impulse noise in the equalized signal".

Examiner's response: The examiner asserts that due to the rebuttal provided for each of the above arguments, Nielsen does disclose "estimating impulse noise in the equalized signal".

Applicant argues: Because of the above, Nielsen does not disclose "removing a portion of the noise form the equalized signal as a function of the estimated impulse noise".

Examiner's response: The examiner asserts that due to the rebuttal provided for each of the above arguments, Nielsen does disclose "estimating impulse noise in the equalized signal".

<u>Independent claim 20</u>

Applicant argues: for similar reasons to those discussed with respect to claims 1-19, neither Arambepola, Nielsen, nor any proper combination of Arambepola and Nielsen teaches or suggests either "an impulse-noise estimator operable to estimate impulse

noise based on the estimated total noise” or a “noise compensator” operable to remove a portion of impulse noise from the equalized signal as a function of the estimated impulse noise.

Examiner’s response: For reasons similar to rebuttal presented based on arguments previously discussed with respect to claim, the combination of Arambepola/Nielsen does suggest both, "an impulse-noise estimator operable to estimate impulse noise based on the estimated total noise” or a “noise compensator” (Nielsen column 1 lines 33-36) operable to remove a portion of impulse noise from the equalized signal as a function of the estimated impulse noise, by considering the combination as a whole, one skilled in the art would be able to discern these elements.

Independent claim 43

Applicant argues: The Examiner is relying on a foreign-language reference for this rejection (in this situation, Schenk is a German-language reference). And Applicant understands the Examiner to be relying on the underlying document, and not simply the abstract, in the rejection. However, the Examiner has failed to provide an English-language translation of Schenk, as required in MPEP 706.02.II.

Examiner’s response: The examiner submits Schenk US Patent 7031410 B1 with this Office Action and maintains the previous rejection.

Independent* claim *46

Applicant argues: The Examiner is relying on a foreign-language reference for this rejection (Schenk is a German-language reference). And Applicant understands the Examiner to be relying on the underlying document, and not simply the abstract, in the rejection. However, the Examiner has failed to provide an English-language translation of Schenk, as required in MPEP 706.02II.

Examiner's response: The examiner respectfully asserts that the Applicant is mistaken regarding the basis of the rejection of claim 46. This claim was rejected based on is corresponding relationship to independent claim 1, (as stated in the previous Office Action) and as such, is not relying on the abstract nor the underlying document of Schenk (German-language reference). Therefore, the rejection is maintained and is clarified in the current Office Action.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1- 20, 34 and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arambepola US PG Publication 2003/0099287 A1 in view of Nielsen US Patent 5692010.

3. With respect to claim 1, Arambepola discloses, estimating (detecting impulsive noise in a stream of sets of samples in a radio receiver and comparing a value base on

an amplitude; paragraph 0004, 0005) impulse noise (paragraph 0011). Arambepola also teaches, removing (blanking to zero) a portion of the noise (paragraph 0003).

4. Arambepola fails to teach that the signal has been equalized as in the claimed invention. However, Nielsen does teach this feature in Figures 1, 2 and 4. An adaptive equalizer receives the signal from the A/D converter, and equalizes it. (Column1 lines 60-62) The advantage being that an improved adaptive equalizer for a digital signal is provided that compensates for impulse noise in the received signal. (Column 1 lines 32-36)

5. Therefore, taking the combined teaching of Arambepola and Nielsen as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method for reducing impulse noise as taught by Arambepola with the method of reducing impulse noise applied to an equalized signal as taught by Nielsen since doing so provides an entire system that would reduce noise energy and propagation effects and substantially reduce symbol-to-symbol noise resulting from impulsive noise. (Arambepola Abstract) Also, an improved adaptive equalizer for a digital signal is provided that compensates for impulse noise in the received signal. (Nielsen Column 1 lines 32-36)

6. Regarding claims 2 and 21, refer to the combined teaching above. Note also that Arambepola teaches the MCM signal is an OFDM signal in paragraph 0020.

7. Regarding claims 3 and 22, refer to the combined teaching above. Note also that Arambepola teaches this feature in Figure 3. The transfer function is the LaPlace or Fourier transform of the impulse response function.

8. Regarding claims 4 and 23, refer to the combined teaching above. Also note that Arambepola teaches this feature in Figure 3 and paragraph 0074.

9. Claims 5 and 24 rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching and in view of Stopler et al US Patent 6920194 B2.

10. Regarding claims 5 and 24, the combined teaching of Arambepola and Nielsen fails to teach that the removing step removes the portion by taking the matrix product of the estimated impulse noise as in the claimed invention. However, Stopler does teach this feature in Figure 3. According to Stopler et al Figure 3, the output of FIFO 40 can be reused for impulse waveform estimation. This is done by multiplying the output of FIFO 40 by matrix $(F'F)^{-1}$, a L*L matrix, with the product being the impulse waveform estimation. (Column 24 lines 33-36) The advantage being that this system a robust and efficient impulse detection system which can adequately detect impulses, which have two or more unknown (or varying) degrees of freedom. (Column 2 lines 67- Column 3 line 21)

11. Therefore, taking the combined teaching and Stopler as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include the removing step removing the portion by taking the matrix product of the estimated impulse noise as taught by Stopler. In so doing the entire system provides an improved technique for detecting and timing impulses which have attributes that span a number of degrees of freedom; the system will also reliably detect an impulse, determine its attributes, and then take appropriate corrective action. (Column 3 lines 10-15).

12. Regarding claims 6 and 25, refer to the combined teaching above. Also note that Arambepola teaches that at least part of the removing step takes place in a frequency domain in Figure 3 and paragraph 0074.

13. Regarding claims 7 and 26 refer to the combined teaching above. Note also, that Stopler teaches subtracting approximated impulse noise from the received signal to form a compensated version of the received-signal. (Column 2 lines 31-33, Column 5 lines 33-41)

14. Claims 8 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching of Arambepola, Nielsen and Stopler in view of Belotserkovsky EP 1178642 A2.

15. Regarding claims 8 and 27, the combined teaching above fails to teach taking the fast Fourier transform (FFT) of the time-domain compensated received-signal to produce a frequency-domain version of the compensated received-signal as in the claimed invention. However, Belotserkovsky does teach this feature in Figure 4; Column 5 lines 33-46) Belotserkovsky goes on to teach taking the product of the frequency-domain version of the compensated received s-signal and an inverse ($\mathbf{H}^{-1}$) of **H**.(Column 6 lines 5-16).

16. Regarding claim 9, refer to the combined teaching above wherein Arambepola teaches approximating total noise in the equalized signal (paragraph 0011). Arambepola also teaches approximating the impulse noise based upon the approximated total noise (paragraphs 0013, 0027).

17. Regarding claims 10 and 28, refer to the combined teaching above wherein Arambepola discloses at least part of the step of approximating the impulse noise (paragraph 0011) takes place in a time domain (Figure 3, paragraph 0074).

18. Claim 11 rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching as applied to claim 1 above, and further in view of Belotserkovsky et al EP 1178642 A2.

19. Regarding claims 11 and 29, the combined teaching fails to disclose use of peak-detection to produce a time-domain version of the estimated impulse noise as in the claimed invention. However, Belotserkovsky et al does teach this feature in Figures 4 and 5. Belotserkovsky also teaches, impulse noise based upon a time-domain version of the approximated total noise in Figure 4, (see also paragraphs 0015, 0023 and 0024) The advantage being that the OFDM receiver filters the FFT retransformed OFDM signal to remove additive channel noise and increase the likelihood of reliable equalizer tap initialization in a low SNR environment. (Column 8 lines14-18) Therefore, taking the combined teaching and Belotserkovsky as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include the peak detection method as taught by Belotserkovsky as in the claimed invention. In so doing, the entire system provides an OFDM receiver filters the FFT retransformed OFDM signal to remove additive channel noise and increase the likelihood of reliable equalizer tap initialization in a low SNR environment. (Column 8 lines14-18)

20. Regarding claims 12 and 30, refer to the combined teaching above wherein Arambepola discloses at least part of the step of approximating the total noise takes place in a frequency domain (Figure 3 paragraph 0074).

21. Claims 13 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching of Arambepola, Nielsen, and Stopler in view of an IEEE article entitled Equalization of OFDM-Systems by interference Cancellation Techniques by Martin Toeltsch and Andreas Molisch

22. Regarding claims 13 and 31, the combined teaching of Arambepola, Nielsen and Stopler discloses estimating a baseband signal that includes a set of transmitted symbols (Arambepola paragraphs 0015-0021). The combined teaching further discloses, subtracting the estimated baseband signal from the equalized signal to form a set of differences (Stopler, Column 3 lines 40-46) The benefit being that this provides a method for compensating for strong impulse interference in a multi-carrier system. (Stopler column 3 lines 6-7) The combined teaching fails to disclose multiplying the set of differences by an estimated channel transfer function (**H**) as in the claimed invention. However, Toeltsch et al does teach this feature in the IEEE article referenced above, wherein Section III Channel interference Matrix describes an equation to multiply the set of differences by an estimated channel transfer function in equation 3. (page 1951 paragraphs 1-3) The benefit being that interference cancellation has mainly been investigated in the context of CDMA systems however the techniques proposed by this method can be applied to the OFDM equalization problem. (page 1950 paragraph 4) Therefore taking the combined teaching and Toeltsch et al as a whole, it would have

been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include the method of multiplying the set of differences by an estimated channel transfer function as taught by Toeltsch. Doing so provides a method for compensating for strong impulse interference in a multi-carrier system. (Stopler column 3 lines 6-7) and interference cancellation has mainly been investigated in the context of CDMA systems however the techniques proposed by this method can be applied to the OFDM equalization problem. (page 1950 paragraph 4).

23. Regarding claims 14 and 32 refer to the combined teaching above wherein Arambepola discloses at least part of the step of approximating the total noise takes place in a time domain (Figure 3 paragraph 0074).

24. Claims 15 and 33 rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching as applied to claim 11 above, and further in view of Richards et al US PG Publication 2002/0061081 A1 and further in view of Belotserkovsky et al EP 1178642 A2.

25. Regarding claims 15 and 33, the combined teaching fails to disclose estimating a baseband signal that includes a set of transmitted symbols as claimed. However, Richards et al does teach this feature in Figures 15, 16, 23 and 24. According to Richards, a data sample is combined with a plurality of nulling samples to produce an adjusted sample. A method of reducing interference involves sampling potential interference in a received signal at a plurality of sampling times near an expected time of arrival of an impulse in an impulse signal (also included in the received signal), to produce a corresponding plurality of interference nulling samples. (paragraph 0025)

The received signal includes the set of transmitted symbols. The advantage being that by reducing interference in an impulse radio receiver, improved signal-to-interference level in the impulse radio is provided. (paragraph 0021) Therefore, taking the combined teaching and Richards as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include estimating the baseband signal that includes a set of transmitted symbols as taught by Richards. Thus, the entire system would reduce interference in an impulse radio without substantially increasing hardware or power requirements in the impulse radio. (paragraph 22)

26. The combined teaching fails to teach that taking the inverse fast Fourier transform (IFFT) of the frequency-domain product to form a time-domain version of the product as claimed. However, Belotserkovsky et al does teach this aspect in Figures 4 and 5. According to Belotserkovsky, The channel estimate is passed to an IFFT unit that applies an inverse Fast Fourier Transform such that the frequency-domain channel estimate is transformed into a time-domain channel estimate. (Column 4 lines 31-36) The advantage being that the OFDM receiver preferably filters the fast Fourier transformed OFDM signal to remove additive channel noise and increase the likelihood of reliable equalizer tap initialization in a low SNR environment. (Column 8 lines 13-17) Therefore, taking the combined teaching and Belotserkovsky et al as a whole it would have been obvious to one of ordinary skill in the art to modify the combined teaching as taught by Arambepola and Nielsen to include the symbol timing recovery in a multi-carrier receiver as taught by Belotserkovsky as claimed. In so doing, the entire system

provides an OFDM receiver preferably filters the fast Fourier transformed OFDM signal to remove additive channel noise and increase the likelihood of reliable equalizer tap initialization in a low SNR environment. (Column 8 lines 13-17)

27. Claims 16 and 35 and 17, 36, 37, 41, 42 rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching of Arambepola, Nielsen, Stopler and Belotserkovsky in view of Frank et al US PG Publication 2003/0035469 A1.

28. Regarding claims 16, 35 and 41, in the combined teaching, Arambepola teaches the estimating step and the removing step can be performed iteratively (paragraph 0004, 0011, 0012). While Belotserkovsky teaches a first such iteration resulting in a first noise-reduced version of the equalized signal (Figure 5, Column 4 lines 5-10) The advantage being that the OFDM receiver preferably filters the fast Fourier transformed OFDM signal to remove additive channel noise and increase the likelihood of reliable equalizer tap initialization in a low SNR environment. (Column 8 lines 13-17) The combined teaching fails to disclose making a second iteration of the estimating step and the removing step in which the estimating step operated upon the first noise-reduced version of the equalized signal. However Frank et al does teach this feature in paragraphs 0017 and 0052. One of ordinary skill in the art would understand that Frank teaches that the second iteration producing a second noise-reduced version of the equalized signal which has a lower noise content than the first version is inherent, based on the fact that the second iteration is performed on the first version. The advantage being that these iterations may be used until a desired level of accuracy is achieved. (paragraph 0010) Therefore, taking the combined teaching and Frank as a

whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include the iterations as taught by Frank and in so doing the entire system provides iterations that may be used until a desired level of accuracy is achieved. (paragraph 0010)

29. Regarding claim 36, refer to the combined teaching above where Frank teaches this feature in paragraph 0017.

30. Regarding claims 17, 37, 38 and 42; refer to the combined teaching above wherein Frank teaches this feature.

31. Claim 18 rejected under 35 U.S.C. 103(a) as being unpatentable over Nokes et al EP 1043874 A2 in view of Greenwood et al EP 1011235 A2.

32. Regarding claim 18, Nokes teaches clipping, prior to equalizing the MCM signal, peaks above a threshold in Figure 1. (Column 3 lines 44 – Column 4 line) The advantage is that the OFDM demodulator itself is able to withstand a higher level of impulsive interference. (Column 2 lines 6-8)

33. Nokes fails to teach that the equalized signal is an equalized version of the clipped MCM signal as in the claimed invention. However, Greenwood does teach this feature. (see Column 3 lines 28-46) The advantage being that this prevents the majority of the impulse power spreading across the OFDM frequency cells. (Column 3 lines 47-48) Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the detection and removal of clipping in multi-carrier receivers as taught by Nokes to include the equalized version of the clipped MCM signal as

taught by Greenwood. Doing so provides a system in which the majority of the impulse power spreading across the OFDM frequency cells. (Column 3 lines 47-48).

34. Regarding claim 19, refer to the combined teaching above wherein Nokes discloses the clipping step clips the MCM signal to either a threshold level or to zero. (Abstract)

35. Claim 20 rejected under 35 U.S.C. 103(a) as being unpatentable over Arambepola/Nielsen as applied to claim 1 above, and further in view of Belotserkovsky EP 1178642 A2.

36. Regarding claim 20, the combined teaching discloses a Fourier transformer operable on the received MCM signal (Arambepola, Figure 3); an impulse-noise estimator operable to estimate impulse-noise (Arambepola, paragraphs 0011, 0012); and a noise compensator operable to remove a portion of impulse noise from the equalized signal as a function of the estimated impulse noise (Nielsen Column 1 lines 35-36,). The Arambepola/Nielsen combination fails to teach an equalizer operable to equalize a Fourier-transformed signal from the Fourier transformer and a total-noise estimator operable to estimate total noise in the equalized signal from the equalizer, as taught in the claimed invention. However, Belotserkovsky does teach both these features in Figures 5 and 4 (respectively). Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Belotserkovsky in the combined teaching since doing so provides versatility in that a Fourier transformed signal can be equalized and more noise forms can be estimated than just impulse noise.

37.

38. Regarding claim 39, refer to the combined teaching that applies the teaching of Arambepola, Nielsen, Stopler and Belotserkovsky. Belotserkovsky teaches the apparatus comprises a first fast Fourier transformer (FFT) to provide a frequency-domain version of the received signal to the equalizer in Figure 4. Belotserkovsky also teaches the impulse-noise estimator includes an inverse FFT (IFFT) and a second FFT in Figure 4. Belotserkovsky further teaches the IFFT providing a time-domain version of the total noise in Figure 4. Moreover, Belotserkovsky teaches the impulse-noise estimator being operable to provide a time-domain estimate of the impulse noise based upon the time-domain estimated total noise. (Column 4 lines 36-43) Also, note that Belotserkovsky teaches that the second FFT being operable to provide a frequency-domain version of the estimated impulse noise. (Column 4 lines 20-25)

39. Claims 43 and 44 are rejected under 35 U.S>C. 103 (a) as being unpatentable over Schenk et al US Patent 7031410 B1 in view of Reuven US Patent 6047022.

40. Regarding claims 43 and 44, Schenk et al, discloses a system in Figure 1 wherein an analog to digital converter (1); a guard-interval removing unit (2); a combined FFT (9), equalization (11) and impulse-noise-compensation unit operable up on a signal from the guard-interval-removing unit. According to the figure, impulse noise cancellation can be performed at various points (8, 10, or 12) in the signal processing chain.

41. Schenk et al fails to teach a down converter as part of the apparatus as in the claimed invention. However, Reuven does teach this feature in Figure 5A. The benefit

being that an apparatus for transmission of high-speed data over communication channels is provided. (Column2 lines 15-18) Therefore, taking the combined teaching of Schenk and Rueven as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the noise cancellation method as taught by Schenk et al to include the down-converter as taught by Reuven. Thus the entire system would provide an improved method of canceling noise. (Schenk, Abstract)

42. Regarding claim 45, which corresponds to claim 2, has already been rejected based on the combined teaching above.

43. Claims 46, 47, and 48 rejected under 35 U.S.C. 103(a) as being unpatentable over Arambepola/Nielsen as taught in claim 1 in view of Belotserkovsky EP 1178642 A2.

44. With respect to claim 46, Arambepola/Nielsen teaches removing a portion of the noise in the received MCM signal in a time domain as a function of the estimated impulse noise (Figure 3, Arambepola) and estimating impulse noise on an equalized signal as discussed previously (Nielsen). However, the combined teaching fails to teach a partially-equalized signal as in the claimed invention, Belotserkovsky does teach such a feature (Column 5 lines 55-57, Figure 5). Therefore, it would have been obvious tone of ordinary skill in the art at the time of the invention to modify the combined teaching of Arambepola/Nielsen to include the equalizer of Belotserkovsky since doing so provides a reliable equalizer (Column 6 line 21).

45. Regarding claim 47 refer to the combined teaching above wherein Belotserkovsky teaches the removing step produces a time-domain compensated signal

(Column 5 lines 33-38) and further discloses equalizing a frequency-domain version of the compensated signal (Column 5 lines 39-57).

46. Regarding claim 48 refer to the combined teaching above wherein Belotserkovsky teaches this feature in Figure 5.

Allowable Subject Matter

47. Claims 34 and 40 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sonia J. King whose telephone number is 571-270-1307. The examiner can normally be reached on Mon-Fri 7:30am-5pm alt Fri's off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammed Ghayour can be reached on 571-272-3021. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Sonia J. King/
Examiner, Art Unit 2611

/Mohammad H Ghayour/
Supervisory Patent Examiner, Art Unit 2611